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The influence of socio-economic factors on *Helicobacter pylori* infection rates of students in rural Zambia

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Abstract

Objectives: Although prevalence of disease in sub-Saharan Africa is often quite high and attracts much research, relatively little is known about less critical maladies. We examined *Helicobacter pylori* infected students in rural Zambia. We attempted to determine if any socio-economic or co-occurring diseases were correlated to *H. pylori* infection. Understanding the context in which *H. pylori* infections occur may increase our understanding of this organism.
Design: We conducted a screening survey with diagnostic tests of primary and secondary school students to determine rates of *H. pylori* infection. We then correlated these rates to socio-economic factors such as income and tobacco use. We also explored the correlation of *H. pylori* to HIV and malaria.
Setting: Zimba, Zambia.
Subjects: Eighty seven primary and secondary school students.
Main Outcome Measure: Correlation of *H. pylori* to socio-economic factors.
Results: *H. pylori* infection was common (60.9%) and was consistent with rates found in other African countries. We found no significant correlation between *H. Pylori* and disease and socio-economic variables.
Conclusion: In the studied population *H. pylori* infection does not appear to be correlated with the measured socio-economic or disease variables.

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Introduction

People in rural sub-Saharan Africa face the interrelated problems of high disease rates, high poverty, and poor access to health care. Diseases such as malaria and Acquired Immunodeficiency Syndrome (AIDS) are widespread, and in many areas are increasing.[1] Furthermore, lack of access to medical resources precludes care for all except in the final stages of disease.

Compounding these problems is a second tier of less severe maladies such as chronic anaemia and colonization with the gastric bacterium *Helicobacter pylori* which is associated with gastric and duodenal ulcers. Although less pressing, these other maladies may interact and affect the morbidity and mortality of diseases such as AIDS and malaria.

Other factors contributing to poor health are socio-economic variables such as income, education, the number of sexual partners, and tobacco use. For example, some studies indicate a positive correlation between *H. pylori* and tobacco smoking[2,3] although other studies either do not support this[4] or have even found a negative correlation.[5,6] Similarly, income and education have been shown to be negatively correlated with *H. pylori* rates in Scotland[3] and Ethiopia,[7] although other studies in South Africa[8] and Senegal[9] have not found this. Furthermore, due to cultural practices, *H. pylori* is correlated to religious affiliation and urban habitation when other socio-economic factors are controlled.[7]

H. pylori is widespread in Africa. Infection rates for adults are 85% in Nigeria,[10] 82.8% in Senegal,[9] and 77.5% in Zaire.[11] In a review of published studies Kidd et *al*[12] found that throughout Africa about 61% of all adults test positive for *H. pylori* but most are asymptomatic.

H. pylori also appears to be contracted at a young age. In Nigeria 82% of those infected acquire the bacterium by age 10;[10] in South Africa 67.3%[13] and 80%[8] by age 10; and in Zaire 66% by age nine.[11]

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Although prevalence of disease in sub-Saharan Africa is often quite high, relatively little is known about associated health and social demographics. We examined students and determined rates of *H. pylori* and then we explored if correlations exist between *H. pylori* and rates of infection with diseases and to socio-economic factors. Understanding the context in which *H. pylori* infections occur may increase our understanding of this organism.

Materials and Methods

Background.

The study was conducted between 19 January 2000 and 19 February 2000 in Zimba, Zambia. Zimba has a population of 4 000 people and is located in rural southwestern Zambia about 70 km north of Livingstone. Most of the people are employed in subsistence agriculture (maize, ground nuts, and cabbage) but a small percentage work as teachers, nurses, and low level government officials. Water is drawn from bore holes and a nearby lake. Health care is limited and is mainly provided by state clinics and a missionary hospital. Maladies of protein deficiency such as Kwashiorkor are as widespread as is HIV. Tuberculosis rates have also experienced a recent increase.

Selection of Subjects.

We surveyed 87 students (40 females and 47 males, aged 14 to 23) at three local schools. One school was a primary day school made up of poor students, one was a technical school of slightly higher income students, and one was a secondary boarding school of more affluent pupils.

An announcement of free screening was made once to all classes that were meeting on one given day. Students readily volunteered and every student in each of the classes we chose went to the clinic. The students were not compensated. Donors were anonymous (given a number and not asked their names) and individual test results were provided if requested.

Parental permission was obtained and ethical approval was given by the Gonzaga University Animal Care and Ethics Committee (12/10/99), the Zimba Mission Hospital Director, and each school Headmaster.

We conducted individual oral interviews and asked the students about age, gender, town of origin, tobacco use number of lifetime sexual partners, past treatment for malaria and present abdominal pain.

We also determined degree of poverty/wealth by asking the students about the occupation of their parents.[14] *Poor* was defined as both parents engaged in subsistence agriculture. *Moderate* as one parent or member in the household working as a nurse, teacher, government official, and/or attending the technical school and *affluent* as able to attend the secondary boarding school. These categories and rankings were confirmed by the class teachers in all cases except one and that student was excluded from the analysis. An attempt was made during data analysis to control for family and extended family size but the different income categories did not differ for this variable.

Parameters such as "past treatment of malaria", and "present abdominal pain" are subjective since fever and/or headache is sometimes referred to as malaria in this geographic region. Additionally "reported abdominal pain" is similarly broad since it may include gynaecological symptoms in adolescent females. However, since we were dealing with children our choice of terms was intended to be subjective. The questions were asked only to establish a general state of health. The actual diagnosis of *H. Pylori*, HIV, or malaria was done using the fluid samples we collected.

Laboratory Tests.

At the Zimba Mission Hospital we drew two millilitres of blood from each student which we tested within 12 hours for HIV, malaria, *H. pylori*, and haematocrit. Blood was drawn by syringe from the median cubital vein and then injected into both a citrated capillary tube and a noncitrated capillary tube. Malaria infection was determined using Field A and B stains and rated by severity as 1+, 2+, and 3+, with 1+ being considered mild and 2+ and 3+ being severe. *H. pylori* was determined using Quickview tests (Quidel Corporation) which is a lateral-flow immunoassay that detects IgG antibodies specific to *H. pylori*. Haematocrit was determined by spinning the capillary tubes and then using a haematocrit reader (Clay Adams Co.). HIV was tested using a Western Blot test (Astra Pharmaceuticals) of blood plasma

Statistical Tests.

We used parametric Pearson Product Moment Correlations (PPMC) for continuous variables or variables with more than three categories and nonparametric Kruskal Wallis One Way ANOVA on Ranks for data with only two categories. Alpha was set to 0.05.

Results

H. pylori was present in 60.9% of the students and it was correlated with lower haematocrit levels (PPMC = -0.250, n = 87, p=0.019, Figure I). Haematocrit was also lower in females (Kruskal Wallis One Way ANOVA, H = 4.45, d.f. = 1, p=0.035) although it was consistent with the normal drop due to menses seen in females when compared to males. *H. pylori* was lower in students who smoked cigarettes but this did not reach statistical significance (Kruskal Wallis One Way ANOVA, H = 3.42, d.f. = 1, p=0.064, Figure II).

Students who smoked reported greater abdominal pain (PPMC = 0.281, n = 87, p = 0.011) and more sexual partners (PPMC = 0.396, n = 87, p=0.0003). Smoking rates were also higher in older age groups with 19 to 23 year olds smoking more than 14 to18 year olds (Kruskal Wallis One Way ANOVA, H = 3.93, d.f. = 1, p=0.047).

The HIV positive rate among students was 9.2%. Infection with HIV was positively correlated with age (PPMC = 0.303, n = 87, p=0.004, Figure III) while *H. pylori* infection was slightly, but not significantly, correlated with age (PPMC = 0.166, n = 87, p=0.125, Figure IV). Only one

Figure I: Pecentage haematocrit levels of those with and without **H. pylori** *infections.*

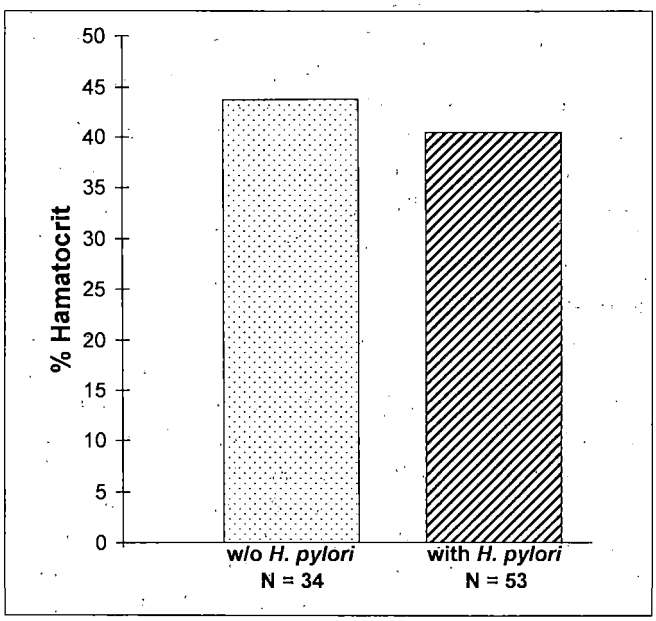


Figure II: **H. pylori** *rates of smokers and nonsmokers of tobacco cigarettes.*

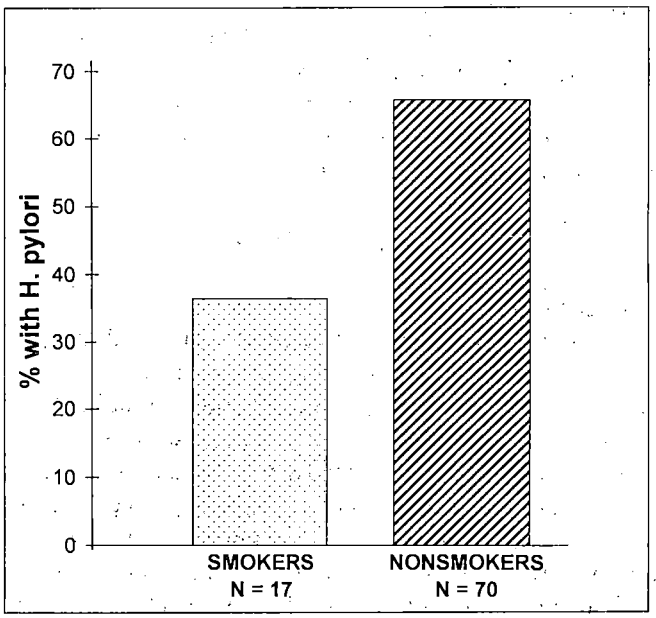


Figure III: HIV infection rates of younger and older students.

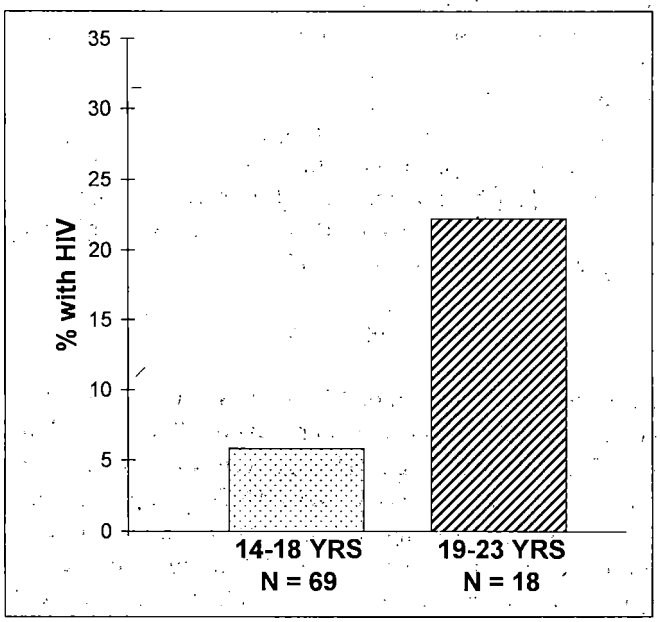
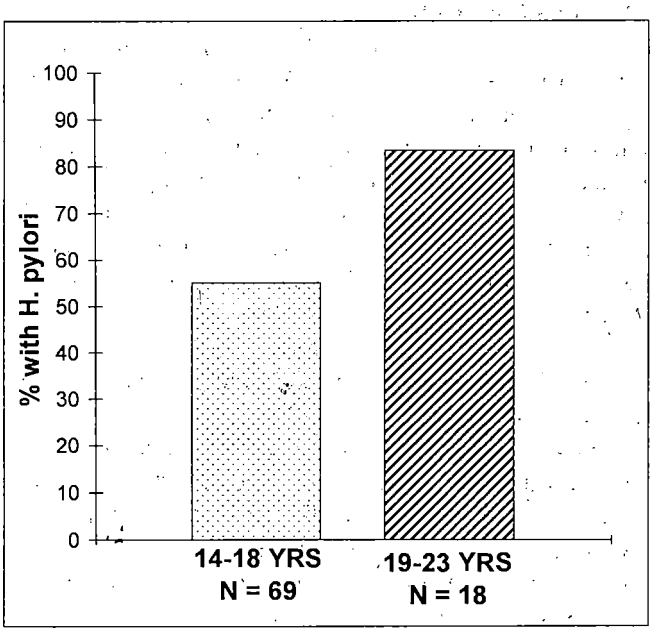


Figure IV: **H. pylori** *infection rates of younger and older students.*



student had an active case of malaria. The lack of other active malaria infections was due to the schools' policies of sending ill students home. However, 77.8% of the students reported past treatment for malaria.

All other possible combinations of variables were not significantly correlated.

Discussion

H. pylori infection was common (60.9%) although it was consistent with rates found in other African countries. *H. pylori* was not statistically correlated with any socio-economic or disease variable that we measured.

We found that *H. pylori* was not correlated to self-reported gastro-intestinal upset. *H. pylori* is often associated with gastro-intestinal upset and ulceration.[12,15] In Zairians with gastroduodenal disorders, *H. pylori* has been found in 87.5% of patients,[11] while another study found rates of 91.7%.[16] However, it is not correlated with self-reported dyspepsia in the United Kingdom[17] or Australia.[18] Studies in more affluent countries like Taiwan[2] and Australia[18] seem to suggest that the debilitating effects of *H. pylori* are higher in men, but studies in Africa have not found this.[8,9,19] We found equal rates of *H. pylori* in both males and females and both reported equal rates of gastro-intestinal upset (39.6%).

H. pylori was correlated with lower haematocrit levels but it is unclear from our correlational data whether *H. pylori* is the cause of lower haematocrit or whether people who are partially anaemic are more susceptible to *H. pylori*.

There has been much debate on the association between *H. pylori* and smoking tobacco. Some studies have found a positive correlation[2,3] while others find no correlation,[4] or a negative correlation.[5,6] We found a nearly significant ($p = 0.064$) negative correlation between smoking and *H. pylori*. Ogihara *et al*[6] argue that since smoking increases gastric acidity it may defend against *H. pylori*. Yet increased gastric acidity could also cause increased peptic ulcers. Indeed, smokers in our study reported significantly greater rates of abdominal pain than non smokers.

In conclusion, in the studied population *H. pylori* infection does not appear to be correlated with the measured socio-economic or disease variables.

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